

In the claims:

1. A network control device, wherein  
a network system is formed of sub-networks having  
different kinds of network architectures, and which  
comprises:

5 a relay service efficiency promoting section  
which reduces physical constraints on a gate way  
mechanism and on a procedure of the mechanism at the  
time of executes a service of relays a message, an  
argument and a response in the network for the linkage  
10 of objects operating on network nodes belonging to said  
sub-networks,

said relay service efficiency promoting section  
having a service registry provided on said gate way to  
store information necessary for accessing a service on  
15 other sub-network.

2. The network control device as set forth in claim  
1, wherein

said relay service efficiency promoting section  
has a service proxy provided on said gate way, said  
5 service proxy having a mechanism of relaying and  
standing proxy for processing to be executed at the time  
of requesting processing from a service on other sub-  
network.

3. The network control device as set forth in claim 2, wherein

said service registries on said plurality of sub-networks share service information autonomously with each other.

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4. The network control device as set forth in claim 1, wherein

said relay service efficiency promoting section has a function of analyzing a service request and conducting message conversion on said gate way.

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5. The network control device as set forth in claim 1, wherein

said sub-network is formed of an information system network, an operation system network, a wireless interconnect and a plurality of lines of portable apparatus interconnects.

5

6. The network control device as set forth in claim 5, wherein

connected to said information system network are a plurality of service nodes, a plurality of service nodes having a gate way function and first and second gate ways connected with each other, connected to said operation system network are said second gate way and a plurality of service nodes, connected to said wireless

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interconnect are said first gate way and other service  
10 node than said service nodes, and respectively connected  
to the plurality of said portable apparatus  
interconnects are portable apparatuses.

7. A network control device, wherein  
a network system is formed of sub-networks having  
different kinds of network architectures, and which  
comprises:

5 a relay service efficiency promoting section  
which reduces physical constraints on a gate way  
mechanism and on a procedure of the mechanism at the  
time of executes a service of relaying a message, an  
argument and a response in the network for the linkage  
10 of objects operating on network nodes belonging to said  
sub-networks,

said relay service efficiency promoting section,  
in a case where relaying is conducted between said sub-  
networks connected in cascade, having a message transfer  
15 mechanism.

8. The network control device as set forth in claim  
7, wherein

said sub-network is formed of an information  
system network, an operation system network, a wireless  
5 interconnect and a plurality of lines of portable  
apparatus interconnects.

9. The network control device as set forth in claim 8, wherein

connected to said information system network are a plurality of service nodes, a plurality of service nodes having a gate way function and first and second gate ways connected with each other, connected to said operation system network are said second gate way and a plurality of service nodes, connected to said wireless interconnect are said first gate way and other service node than said service nodes, and respectively connected to the plurality of said portable apparatus interconnects are portable apparatuses.

10. A network control device, wherein

a network system is formed of sub-networks having different kinds of network architectures, and which comprises:

a relay service efficiency promoting section which reduces physical constraints on a gate way mechanism and on a procedure of the mechanism at the time of executes a service of relaying a message, an argument and a response in the network for the linkage of objects operating on network nodes belonging to said sub-networks,

said relay service efficiency promoting section having a virtual machine as a mechanism for executing a

portable code independent of execution environments  
15 mounted on said gate way and having a function of  
loading and executing a protocol-dependent portion of a  
service proxy through the network.

11. The network control device as set forth in claim  
10, wherein

said sub-network is formed of an information  
system network, an operation system network, a wireless  
5 interconnect and a plurality of lines of portable  
apparatus interconnects.

12. The network control device as set forth in claim  
11, wherein

connected to said information system network are  
a plurality of service nodes, a plurality of service  
5 nodes having a gate way function and first and second  
gate ways connected with each other, connected to said  
operation system network are said second gate way and a  
plurality of service nodes, connected to said wireless  
interconnect are said first gate way and other service  
10 node than said service nodes, and respectively connected  
to the plurality of said portable apparatus  
interconnects are portable apparatuses.

13. A network control device, comprising:  
a sub-network node formed of an information

system network, an operation system network, a wireless  
interconnect and a plurality of lines of portable  
5 apparatus interconnects, first, second and third sub-  
networks mounted with different kinds of  
protocols/profiles, a first gate way/proxy which  
connects said first and said third sub-networks and a  
second gate way/proxy which connects said second and  
10 said third sub-networks, wherein

processing of a physical layer and a data link  
layer is mounted as protocols of said first, said second  
and said third sub-networks, and which further  
comprises:

15 a common transport layer, and a service proxy and  
a client proxy shared by said first and said third sub-  
networks.

14. The network control device as set forth in claim  
13, wherein

first and second service message conversion  
processing and message forwarding processing are mounted  
5 which are operable in response to connection between  
said first, said second and said third sub-networks  
under the control of said service proxy and said client  
proxy.

15. The network control device as set forth in claim  
13, wherein

a property holding service registry for a service existing on the network formed of said first, said  
5 second and said third sub-networks is arranged on each of said first and said second gate ways.

16. The network control device as set forth in claim 13, wherein

said first and said second gate way proxies have portions for executing processing dependent on a service  
5 of said service proxy described with a portable code independent of execution environments and include a virtual machine/execution environment for executing said service-dependent processing as set forth in the description.

10 17. A network control method, wherein

a network system is formed of sub-networks having different kinds of network architectures, and

a relay service efficiency promoting section  
5 which reduces physical constraints on a gate way mechanism and on a procedure of the mechanism at the time of executes a service of relays a message, an argument and a response in the network for the linkage of objects operating on network nodes belonging to said  
10 sub-networks, and which comprises:

a network initialization step by said relay service efficiency promoting section, in a case where

relaying is conducted between said sub-networks  
connected in cascade, of conducting setting or  
15 determination of a physical layer address, determination  
of a logical address in said sub-network, activation of  
a network management service and activation of an  
applied service as set forth in a network initialization  
procedure defined for each said sub-network by using a  
20 message transfer mechanism,

a service registration step of registering a  
service to be brought to be public among services of  
said sub-networks to other sub-network,

a service using step of using a registered  
25 service, and

a service registration erasing step of erasing  
registration of said service after the use of said  
service.

18. The network control method as set forth in claim  
17, wherein

said service registration step includes  
processing of a procedure on a service node in which a  
5 service to be registered is included and processing of a  
procedure of a service registry on a gate way node  
paired with the service node.

19. The network control method as set forth in claim  
18, wherein



said processing of a procedure on the service node includes:

5           a step of confirming that the service in question is already registered in a service registry node,

          a registry registration initialization step to be conducted with respect to said service node when the registration is yet to be completed,

10           a step of transmitting a service registry registration request to said service registry node, and

          a step of, upon receiving a registration request acceptance notification from said service registry node, transmitting registry registration information to said

15           service registry node and when other service exists which is to be registered among services belonging to the node, repeating the same processing to end the registration when the processing is completed.

20.       The network control method as set forth in claim 18, wherein

          said service registry procedure processing includes:

5           a registry registration initialization step to be conducted by said service registry node after activation,

          a step of waiting for a registry registration request from said service node,

          a step of receiving a service registration request transmitted from said service node side to

10

accept the registration request,

a step of notifying said service node as a requesting source that registration of the service is possible to execute registry registration of receiving  
15 registry registration information from said service node side and issuing a registration completion notification to said service node side, and

a step of, upon completion of registration of all the services to be brought to be public to other sub-  
20 network among said sub-networks, transmitting information, out of the contents, to be held in a service registry on other sub-network to the service registry in question to end the processing.

21. The network control method as set forth in claim 18, wherein

said service using processing includes a service using step of a service using node, a service search  
5 step in a service registry on a service using side sub-network, a service using step of a user side service proxy, a service using step of a service providing side service proxy and a service using step of a service providing side service node.

10 22. The network control method as set forth in claim 21, wherein

said service using processing of a service using

node includes the steps of:

5           transmitting a service search request to a  
service registry for the search of a service to be used  
with the entire network as a target,

          selecting a service optimum for a purpose among  
service information of a search result received from  
10       said service registry to determine the service and a  
proxy on the corresponding owned sub-network,

          issuing a service request to the determined  
service proxy from the service using node to wait for  
return of a result of the service thereafter,

15       upon return of a result of said service from said  
service proxy, referring to the contents to proceed with  
the processing, and

          repeating the same processing when requesting the  
same service again and ending the processing when the  
20       service is not used.

23.       The network control method as set forth in claim  
22, wherein

          said processing of waiting for a service result  
to be returned includes issuance of a service request to  
5       said determined service proxy from the service using  
node as well as issuance of information corresponding to  
a necessary argument.

24.       The network control method as set forth in claim

21, wherein

said service search processing in said service registry includes the steps of:

5 receiving said service search request from said service using node by said service registry on the user side to search for registry information in the owned node,

10 returning service information relevant to a search key obtained as a result of the search to software of said service using node, and

completing the search by said service registry to again wait for a next search request.

25. The network control method as set forth in claim 21, wherein

said service using processing includes:

5 a service using step at the user side service proxy for linking services on different sub-networks, and

a service using step at the provider side service proxy.

26. The network control method as set forth in claim 21, wherein

until the end of the service, said service using processing at said user side service proxy continues:

5 a step of monitoring a service request made from

a node in a sub-network belonging to said service using side proxy,

10           a step by said user side service proxy of, upon receiving a service request, interpreting the service request and after conducting predetermined message conversion, transferring the message to a provider side service proxy to which a node providing the service in question belongs and monitoring arrival of a service execution result after the transfer, and

15           a step of, upon receiving said service execution result from said provider side service proxy, conducting message conversion to transmit the message to a service proxy designated by the service requesting side node.

27.       The network control method as set forth in claim 21, wherein

5           until the end of the service, said service using processing at said provider side service proxy continues the steps of:

          monitoring a service request made from said user side service proxy,

10           upon receiving said service request, interpreting the service request, converting the request into a message system on the owned sub-network and transferring the message to a provider side node,

          thereafter monitoring arrival of a service execution result from said provider side node, and

15           upon receiving said service execution result,  
converting the result into a message to transmit the  
message toward a service proxy designated by said  
service requesting node.

28.       The network control method as set forth in claim  
21, wherein

          the service using processing of the service  
provider side service node includes the steps of:

5           monitoring arrival of a service request,  
          upon arrival of said service request,  
interpreting a request message to execute a service to  
be provided, and

          returning an execution result to a service proxy  
10       on a transmission source's own sub-network to end the  
steps of one service request.

29.       A network control method, wherein

          a network system is formed of sub-networks having  
different kinds of network architectures, and which  
comprises:

5           a relay service efficiency promoting section  
which reduces physical constraints on a gate way  
mechanism and on a procedure of the mechanism at the  
time of executes a service of relaying a message, an  
argument and a response in the network for the linkage  
10       of objects operating on network nodes belonging to said

sub-networks, and wherein

said relay service efficiency promoting section,  
in a case where relaying is conducted between said sub-  
networks connected in cascade, by a message forwarding  
15 function included in the message transfer mechanism,  
sends a converted message to a target sub-network at the  
time of service linkage between sub-networks not  
directly connected in terms of network topology to  
conduct a service between a service using node and a  
20 service providing node on the target sub-network without  
repeating message conversion.

30. The network control method as set forth in claim  
19, wherein

with a virtual machine as a mechanism for  
executing a predetermined portable code mounted on the  
5 gate way, when a function of loading and executing a  
protocol-dependent portion of a service proxy on said  
gate way through the network is provided, said  
processing of a procedure on the service node includes:

a step of confirming that the service in question  
10 is already registered,

an initialization step of registration in a  
registry and registration of service-dependent  
processing codes of said service proxy and client proxy  
to be conducted with respect to said service node when  
15 the registration is yet to be completed,

a step of transmitting a service registry  
registration request to said service registry node, and

20 a step of, upon receiving a registration request  
acceptance notification from said service registry node,  
transmitting registry registration information and the  
portable codes of the service-dependent processing of  
the service proxy and the client proxy to said service  
registry node and when other service exists which is to  
be registered among services belonging to the node,  
25 repeating the same step to end the registration when the  
step is completed.

31. The network control method as set forth in claim  
18, wherein

said service registry procedure step includes:

5 a registry registration initialization step to be  
conducted by said service registry node after activation,

a step of waiting for a registry registration  
request from said service node,

10 a step of receiving a service registration  
request transmitted from said service node side to  
accept the registration request,

a step of notifying said service node as a  
requesting source that registration of the service is  
possible to execute each service registry and client  
registry registration of receiving registry registration  
15 information and a portable code of service-dependent



processing of a service proxy and a client proxy from  
said service node side and issuing a registration  
completion notification to said service node side, and

20           a step of, upon completion of registration of all  
the services to be brought to be public to other sub-  
network among said sub-networks, transmitting  
information, out of the contents, to be held in a  
service registry on other sub-network to the service  
registry in question, as well as transmitting the  
25       portable codes of said service proxy and client proxy to  
the corresponding said service proxy and said client  
proxy to end the processing.

32.       A program which causes a computer to execute  
procedure processing on a service node, comprising:

          a function of confirming that a service in  
question is already registered in a registry,

5           a registry registration initialization function  
to be conducted with respect to a service node when the  
registration is yet to be completed,

          a function of transmitting a service registry  
registration request to a service registry node, and

10          a function of, upon receiving a registration  
request acceptance notification from said service  
registry node, transmitting registry registration  
information to said service registry node and when other  
service exists which is to be registered among services

15        belonging to the node, repeating the same processing to  
end the registration when the processing is completed.

33.        A program which causes a computer to execute  
procedure processing of a service registry, comprising:

          a registry registration initialization function  
to be conducted by a service registry node after  
5        activation,

          a function of waiting for a registry registration  
request from a service node,

          a function of receiving a service registration  
request transmitted from said service node side to  
10        accept the registration request,

          a function of notifying said service node as a  
requesting source that registration of the service is  
possible to execute registry registration of receiving  
registry registration information from said service node  
15        side and issuing a registration completion notification  
to said service node side, and

          a function of, upon completion of registration of  
all the services to be brought to be public to other  
sub-network among said sub-networks, transmitting  
20        information, out of the contents, to be held in a  
service registry on other sub-network to the service  
registry in question to end the processing.

34.        A program which causes a computer to execute

service using processing of a service using node,  
comprising the functions of:

transmitting a service search request to a  
5 service registry for the search of a service to be used  
with the entire network as a target,

selecting a service optimum for a purpose among  
service information of a search result received from  
said service registry to determine the service and a  
10 proxy on the corresponding owned sub-network,

issuing a service request to the determined  
service proxy from the service using node to wait for  
return of a result of the service thereafter,

upon return of a result of said service from said  
15 service proxy, referring to the contents to proceed with  
the processing, and

repeating the same processing when requesting the  
same service again and ending the processing when the  
service is not used.

20

35. A program which causes a computer to execute  
service search processing in a service registry,  
comprising the functions of:

receiving a service search request from a service  
5 using node by a user side service registry to search for  
registry information in the owned node,

returning service information relevant to a  
search key obtained as a result of the search to

software of said service using node, and

10                    completing the search by said service registry to  
again wait for a next search request.

36.        A program which causes a computer to execute  
service using processing in a user side service proxy,  
comprising:

             a function of monitoring a service request made  
5        from a node in a sub-network belonging to a service  
using side proxy,

             a function by the user side service proxy of,  
upon receiving a service request, interpreting the  
service request and after conducting predetermined  
10        message conversion, transferring the message to a  
provider side service proxy to which a node providing  
the service in question belongs and monitoring arrival  
of a service execution result after the transfer, and

             a function of, upon receiving said service  
15        execution result from said provider side service proxy,  
conducting message conversion to transmit the message to  
a service proxy designated by the service requesting  
side node.

37.        A program which causes a computer to execute  
service using processing in a provider side service  
proxy, comprising the functions of:

             monitoring a service request made from a user

5 side service proxy,

upon receiving said service request, interpreting the service request, converting the request into a message system on the owned sub-network and transferring the message to a provider side node,

10 thereafter monitoring arrival of a service execution result from said provider side node, and

upon receiving said service execution result, converting the result into a message to transmit the message toward a service proxy designated by said service requesting node.

15

38. A program which causes a computer to execute service using processing in a service provider side service node, comprising the functions of:

monitoring arrival of a service request,

5 upon arrival of said service request,

interpreting a request message to execute a service to be provided, and

returning an execution result to a service proxy on a transmission source's own sub-network to end the processing of one service request.

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